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Semi Annual Report for NsG-689

The Institute of Molecular Evolution of the University of Miami has continued its earlier studies of laboratory abiogenesis, has initiated new studies in this area, and has begun a new program in organic geochemistry.

Papers on catalytic activity in thermal proteinoids for *p*-nitrophenyl acetate were published in the January issue of the Archives of Biochemistry and Biophysics. New findings which have not been brought to published form include the transaminase activity in combinations of appropriate thermal proteinoid and Cu^{++} ions. This work has been done by Dr. Krampitz at the University of Bonn. At the Federation meeting, April 1967, Dr. Tairo Oshima of the Ames Research Center is reporting the activity of thermal proteinoids for the hydrolysis of *p*-nitrophenyl phosphate. The kinds of reactions which have now been shown to be catalyzed by thermal proteinoids include hydrolysis of esters, decarboxylation, transamination, and hydrolysis of phosphates. The potency for hydrolysis of phosphates is of particular interest in the search for ATP-dependent polymerization reactions.

In the February issue of Archives of Biochemistry and Biophysics has been published the production of a second kind of proteinoid, the so-called Leuchs proteinoid. These are prepared through moderately intricate organic chemical reactions from the Leuchs anhydrides of the amino acids. Nine of them must be protected in order to carry out this condensation. These nine were protected in such a way that the blocked groups could be simultaneously removed by hydrogenolysis in liquid ammonia with sodium.

A first publication of a model of proliferation of proteinoid microspheres appeared in Comparative Biochemistry and Physiology, March 1967. In this is demonstrated how in a very simple way the ability of proteinoid microspheres to participate in the reproduction of their own likeness is intrinsic to the unit and its contained material. This particularly signal effect climaxes a list of overwhelmingly simple phenomena which are intrinsic to thermal proteinoids and which they, in organized form, have in common with contemporary cells.

The compositional control of proteinoids to yield histone-like polymers has been studied intensively and extensively. When the ratio of basic amino acid to acidic amino acid rises significantly above 1.0, the proteinoids are found to bind markedly with polynucleotides. Studies based on this binding capacity are proceeding. One great advantage of the synthetic technique employed in these studies is that it permits forming disciplined judgments on the precise nature of the need for polynucleotides or nucleic acids in the contemporary cell. Results obtained to date indicate that adequate limitation of heterogeneity, a kind of reproductive process, and other salient features could exist solely on the basis of the polyanhydro- α -amino acid.

Preliminary results have indicated that proteinoid microspheres stained with Crystal Violet can absorb light energy to accelerate the decomposition of pyruvic acid.

The program in organic cosmochemistry and organic geochemistry has intensified during this period, particularly with the association of Professor George Mueller. Professor Mueller has instituted the following lines of study:

1. Distribution pattern of amino acids in coals of different geological ages.
2. Study of the mechanism of hydrothermal differentiation of carbonaceous complexes in Derbyshire, England and other localities of the globe.
3. Several investigations on the interrelations between percentage of volatiles, the type of carbonaceous complex, and statistical topography of chondrites.
4. Participation in plans for lunar analysis, both in the Institute and at the program review held at Goddard Space Flight Center in February, 1967.

Professor Mueller has the following invited chapters in press: "Meteorites," for a book by J. D. Bernal; "High Temperature Processes in Organic Geochemistry" for the serial, *Advances in Organic Geochemistry*; and chapters in the *Encyclopedia of Earth Sciences* on a) Nitrates, b) Organic Cosmochemistry, c) Organic Geochemistry, and d) Organic Mineralogy.

Microspheres resembling in appearance the kinds obtained from proteinoid have been found as inclusions in samples of quartz from South Africa. These are being examined in the laboratory of Dr. Jerome Wolken to determine if they are protein-like in composition.

Asymmetric syntheses of α -amino acids from their corresponding α -keto acids or their derivatives are now in progress by Dr. Harada and Mr. Matsumoto. In each of the studies, the steric courses were investigated. Completed works have been published or are in press in four papers since September, 1966.

Studies of the stereochemistry of β -hydroxy α -amino acids and derivatives of glycidic acids are also under investigation (two papers published).

In progress also are studies of the nonenzymatic transamination between α -keto acids and α -amino acids, and on the mechanism of amino acid

formation by oligomerization of hydrogen cyanide.

Members of the Institute have, as before, been in demand for the presentation of their work. Professor Metz is co-authoring a book with Alberto Munro entitled Gamete Physiology and Fertilization Mechanisms in Plants and Animals. Invitations for chapters by Professor Mueller have been indicated above. Professor Harada has been requested to write a review on The Formation of Biochemical Substances and the Origin of Living Bodies and on The Addition Reaction to the Azomethine Groups. Professor Fox has found time to accept some invitations to speak and write. Recent among these is the invited chairmanship of the Colloquium on Cosmobiology and Geobiology for the Seventh International Congress of Biochemistry at Tokyo in August, 1967, and the presentation of a lecture on his research at an international meeting of biochemists of the United Kingdom and of India in Bangalore in September, 1967. He is coauthoring with Cyril Ponnamperna a book on Molecular Evolution.